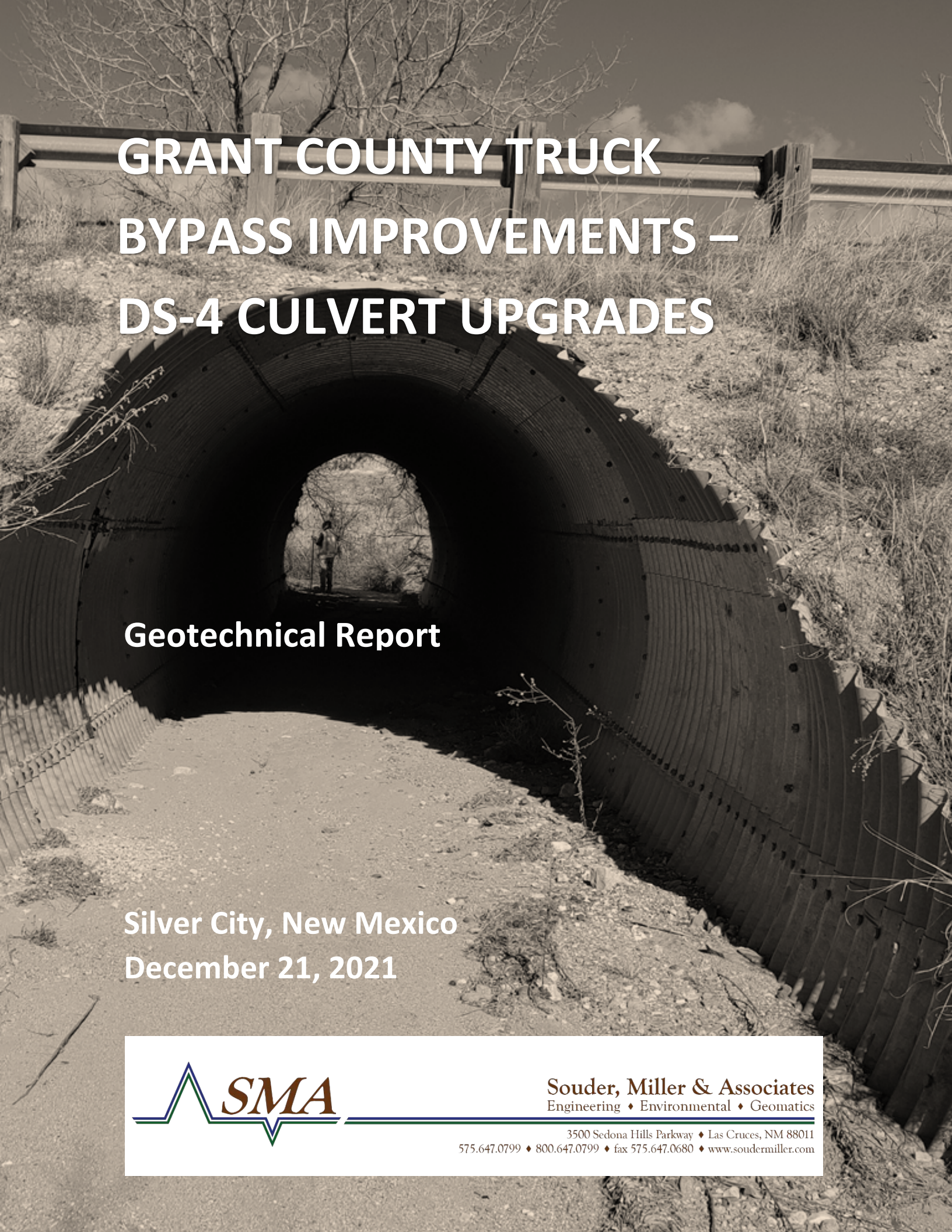


GRANT COUNTY TRUCK BYPASS IMPROVEMENTS – DS-4 CULVERT UPGRADES

Geotechnical Report

Silver City, New Mexico
December 21, 2021

SMA
Souder, Miller & Associates
Engineering ♦ Environmental ♦ Geomatics
3500 Sedona Hills Parkway ♦ Las Cruces, NM 88011
575.647.0799 ♦ 800.647.0799 ♦ fax 575.647.0680 ♦ www.soudermiller.com

Souder, Miller & Associates ♦ 3500 Sedona Hills Parkway ♦ Las Cruces, NM 88011
(575) 647-0799 ♦ (800) 647-0799 ♦ fax (575) 647-0680

December 21, 2021 #7328699

Ms. Priscilla A. Shoup
Planning & Community Development Director
Grant County
1400 East Highway 180
Silver City, New Mexico 88061

RE: Grant County Truck Bypass Road Improvements – DS4 Culvert Upgrades
Silver City New Mexico
Geotechnical Report

Dear Ms. Shoup:

Souder, Miller and Associates is pleased to present the enclosed final Geotechnical Report for the above referenced project. The report analyzes the existing subgrade soils within the right-of-way of an existing 12-foot metal culvert, identified as DS-4, located along the northwestern portion of the Truck Bypass Road in Silver City, New Mexico and recommends applicable pavement sections for the improvements of Truck Bypass Road.

Should you have any questions, require any further information or if any portion of the report requires modification to meet your specific needs, please do not hesitate to contact our office.

Sincerely,

MILLER ENGINEERS, INC. D/B/A
SOUDER, MILLER & ASSOCIATES

Sarah V. Garduño, EIT
Staff Civil Designer
sarah.garduno@soudermiller.com

Paul J. Pompeo, PE
Technical Sector Director
paul.pompeo@soudermiller.com

Enc: Grant County Truck Bypass Road Improvements Project -DS4 Culvert Upgrades Geotechnical Report

GEOTECHNICAL INVESTIGATION

GRANT COUNTY TRUCK BYPASS ROAD IMPROVEMENTS – DS4 CULVERT UPGRADES

SILVER CITY, NEW MEXICO

Prepared for

Grant County
Roads Department
1400 East Highway 180
Silver City, New Mexico 88061

December 21, 2021

This document was prepared under the supervision and direction of the undersigned whose seal as a Professional Engineer, licensed to practice as such in the State of New Mexico, is affixed below.

Paul J. Pompeo, P.E.

11490 — NMPE Number

12/21/2021 — Date

Table of Contents

List of Appendices

GEOTECHNICAL REPORT

GRANT COUNTY TRUCK BYPASS IMPROVEMENTS – DS4 CULVERT UPGRADES
Silver City, New Mexico

December 21, 2021

1.0 Introduction

Souder, Miller and Associates (SMA) was retained by Ms. Shoup, the Planning and Community Development Director of Grant County to prepare the following geotechnical investigation report. From the site's subsurface investigation through obtaining soil test borings, the nature of the substrata soils will be determined, and its characteristics ascertained. This information shall then be used to provide foundation design and earthwork recommendations for the DS4 Culvert upgrades. A project location map and boring location maps are in Appendix A.

2.0 Scope of Work

The intent of the investigation is to obtain subsurface data at the site and provide recommendations for the design of the existing DS-4 culvert structure replacement. The extent of this subsurface study included the drilling of 2 soil test borings and the laboratory testing of these soil samples collected from the site. All testing and drilling were completed by technicians from the drilling and soils testing subcontractor, Southwest Engineering, Inc. (SEI). Further discussion of the findings is in Section 5.0. These findings include:

- A review of test procedures
- A review of site and subsurface conditions
- Boring logs and laboratory test results
- Earthwork recommendations.

3.0 Site Description

A review of the project site was made by SMA personnel prior to drilling operations to document the current site conditions and characteristics. Truck Bypass Road is located southwestern portion of Silver City, New Mexico. The repairs are anticipated to begin approximately 0.25-miles southwest of the intersection of U.S Highway 180 and Truck Bypass Road. The immediate area is currently an existing drainage structure within a paved road. The north side and south side of the project area is a natural drainage channel ranging in width and depths. Property to the east and west is the right-of-way of Truck Bypass Road surrounded by residential homes and vacant areas. Development of the area will include modifications to the existing roadway, as per the Pavement Design Report prepared by SMA and upgrades of the existing culvert.

4.0 Investigation Procedures

The general field procedures employed by SMA are summarized in ASTM Specification D-420 entitled "Investigation and Sampling Soils and Rocks for Engineering Purposes." This recommended practice lists recognized methods for determining soil and rock distribution and groundwater conditions. These methods include geophysical and in situ methods as well as borings.

A CME-85 Drilling Rig, mounted on a Kenworth T800, equipped with hollow-flight augers, penetration and soil sampling equipment was used on this project. Borings are drilled to obtain subsurface samples using one of three alternate techniques depending upon the subsurface conditions. These techniques are continuous 2¼ or 8¼ inch I.D. hollow stem augers, wash borings using roller cone or drag bits (mud or water) or continuous flight augers (ASTM D1452). These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

The subsurface conditions encountered during drilling are reported on a field test boring record by the SEI Chief Driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observation of groundwater. It also contains the driller's interpretation of the soil conditions between samples. Therefore, these boring records contain both factual and interpretive information.

The soil and rock samples plus the field boring records are reviewed by the engineering staff at SMA. The staff classifies the soils in general accordance with the procedures outlined in ASTM Specification D2488 and prepares the final boring records which are the basis for all evaluations and recommendations. The final test boring records represent our interpretation of the contents of the field records based on the results of the engineering examination and test of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at the boring locations. Also, the passage of time may result in a change in the subsurface soil and groundwater conditions at these boring locations. The lines designating the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The actual transition between materials may be gradual. The boring records are included in Appendix B.

The borings were drilled using hollow-stem augers and solid-flight augers, as noted on the Boring Logs. Penetration testing and split barrel sampling were conducted in the borings at regular intervals.

The standard penetration test (SPT) provides an indication of the soil strength and compressibility. The SPT resistances and split barrel sampling are conducted simultaneously according to ASTM Specification D1586. At regular intervals, the drilling tools are removed, and soil samples obtained with a standard split tube sampler. The sampler is first seated six inches, to penetrate any loose cuttings, then driven an additional foot with blows of a 140-pound hammer falling thirty inches. The number of hammer blows required to drive the sampler the final foot is recorded and is designated the "penetration resistance".

5.0 Subsurface Conditions

The subsurface condition of the project area was determined from 2 soil test borings. The boring locations were selected by SMA and the Client after a review of the project site. The soil test borings were drilled at the locations shown on project map attached in Appendix A. From the existing site grade, the soil test borings were advanced to a depth of 31.5-feet. Disturbed samples were obtained during this test and were used to classify the soils.

The subsurface conditions encountered are shown in the boring logs in Appendix B. These records represent our interpretation of the subsurface conditions based on field logs, visual examination of field samples and laboratory testing of representative field samples. The lines designating the interface between various strata on the boring logs represent the approximate interface location. In reality, the transition between strata may actually be gradual.

5.1 Soil And Rock Conditions

The soil profile of the test holes shows the following:

Boring Number D1								
		% Passing						
Depth, (ft)	Material Description	#10	#40	#200	PI	LL	AASHTO Class	"R" Value
0 to 2.5 +/-	Dark Brown Silty Clayey Sand w. Gravel	53	28	17.7	S/NP	S/NP	A-2-4	50
2.5 to 5.0 +/-	Dark Brown Sandy Fat Clay w. Gravel	51	35	26.4	46	56	A-2-7	5
5.0 to 7.5 +/-	Dark Brown Sandy Fat Clay w. Gravel	71	53	42.6	45	61	A-7	5
7.5 to 10 +/-	Brown Sandy Fat Clay w. Gravel	69	65	47	31	52	A-7	5
10 to 15 +/-	Brown Sandy Lean Clay w. Gravel	62	44	32.4	24	44	A-2-7	14
15 to 20 +/-	Brown Silty Sand w. Gravel	44	30	19.2	S/NP	S/NP	A-2-4	50
20 to 25 +/-	Burnt Red Sandy Lean Clay	82	62	50.6	32	49	A-7	5
25 to 30 +/-	Burnt Red Sandy Fat Clay	84	69	59.5	37	57	A-7	5
30 to 31.5 +/-	Burnt Red Sandy Fat Clay	93	73	63.5	34	55	A-7	5

Boring Number D2								
		% Passing						
Depth, (ft)	Material Description	#10	#40	#200	PI	LL	AASHTO Class	"R" Value
0 to 2.5 +/-	Gray Silty Clayey Sand w. Gravel	58	32	24.6	S/NP	S/NP	A-2-4	50
2.5 to 5.0 +/-	Brown Sandy Lean Clay w. Gravel	64	41	32.9	28	48	A-2-7	8
5.0 to 7.5 +/-	Brown Sandy Lean Clay w. Gravel	64	41	31	27	47	A-2-7	10
7.5 to 10 +/-	Brown Sandy Lean Clay w. Gravel	63	42	31.8	22	46	A-2-7	17
10 to 15 +/-	Brown Sandy Lean Clay w. Gravel	63	43	34	24	46	A-2-7	14
15 to 20 +/-	Dark Brown Sandy Lean Clay	82	70	55.8	22	39	A-7	7
20 to 25 +/-	Burnt Red Sandy Lean Clay	81	52	26.7	26	42	A-2-7	11
25 to 30 +/-	Burnt Red Sandy Lean Clay w. Gravel	59	48	34.2	31	50	A-2-7	5
30 to 31.5 +/-	Burnt Red Sandy Lean Clay	82	56	40.8	29	47	A-7	5

5.2 GROUNDWATER

Groundwater was ***NOT*** encountered within the borings on this project site at the time of exploration.

5.3 SOIL CHEMISTRY

No laboratory tests were performed to determine the chemical properties of the surface soils within the project area, although record data was reviewed to determine the general soil properties. Soil properties were determined from soil survey information accessed on-line via the United States Department of Agriculture Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. The soil(s) found within the project location are as follows:

Soil Chemistry Summary						
Soil Type	Soil Name	Hydrologic Soil Classification	pH Range	Salinity (milliohm/cm)	Risk of Corrosion Untreated Steel	Risk of Corrosion Concrete
27	Lonti-Denver Variant Complex (1% to 25% Slopes)	C	6.6 to 8.4	0.0 – 4.0	Moderate	Low

In accordance with ASTM C150 and C150M as well as a review of soil types, Type I or Type IA cement can be used for most concrete foundations. If drainage structures are anticipated to have moderate to high sulfate concentrations, Type II cement should be used.

6.0 Discussion and Recommendations

6.1 General Project Criteria

The primary objective of this report was to review the in-situ soils located beneath and within the vicinity of the existing drainage structure identified as DS4 and provide recommendations for foundation system, and upgrades. The proposed upgrades entail a concrete box culvert.

6.2 General Earthwork Recommendations

Results from the subsurface investigation of the project site found that soils are predominately classified as sands with gravel and lean clay with gravel materials. As such, the site soils are inadequate for the structure to be directly constructed and mitigation steps must be undertaken to prior to construction.

SMA recommends over-excavating and replacing a minimum of 3-feet of existing soils located vertically beneath the proposed concrete box culvert structure and 3-feet of existing soils located laterally from the outside face of the structure with engineered fill materials. Engineered fille materials shall be moisture treated, and recompacted to the appropriate soil density as specified below. The proposed structure shall have an allowable bearing capacity of 2,000 psf.

Fill and/or backfill materials if required and as a minimum, shall meet the requirements set forth in Section 7.0 and shall be placed in compacted layers not to exceed 6 inches in thickness. All fill materials shall be moisture treated to a level of +/- 2 percent of optimum and compacted to 95 percent of ASTM D1557. The top layer of native material below any excavated area shall be scarified, moisture treated to a level of +/- 2 percent of optimum and compacted to 95 percent of ASTM D1557.

6.3 *RETAINING STRUCTURES*

The fill and/or backfill soils to be used on this project shall be cohesionless and follow the requirements of Section 7.0. The following values will be used for the design of retaining structures within the project area, as applicable.

Retaining Structure Design Parameters	
Allowable Bearing Capacity	1,500 psf
Soil Unit Weight[(1)]	118 pcf
Soil Angle of Internal Friction [(2)]	30º
Coefficient of Friction (Soil to Concrete) [(3)]	0.25
Active Earth Pressure, K_a (Level backfill)	40 pcf
Passive Earth Pressure, K_p (Level backfill)	354 pcf
At Rest Earth Pressure, K_o (Level backfill)	59 pcf

(1) – From historical proctor information of the surrounding area.
(2) – From "Foundation Analysis" by Bowels
(3) *– From the International Building Code, Table 1806.2*

6.4 *SEISMIC LOADS*

Seismic design considerations following the requirements of the 2015 NEHRP Provisions. Design values are calculated on the United State Geologic Survey website, "Earthquake Hazards Program" at http://earthquake.usgs.gov/designmaps/us/application.php.

Site Location Information		
Risk Category[(1)]	I, II, or III	
Site Soil Classification [(2)]	D	
Location	Latitude	Longitude
	32.757034°	-108.309813°
Seismic Design Parameters (g)		
S_S	S_{MS}	S_{DS}
0.257	0.409	0.273
S_1	S_{M1}	S_{D1}
0.077	0.185	0.124

(1) – From the International Building Code, Table 1806.2
(2) – From the International Building Code, Table 1613.5.2

6.5 SETTLEMENT EVALUATION

Based on the soil properties found within the project site and the anticipated foundation loads, there is a potential for settlement. The following estimated settlement values have been theorized for site development options using conventional shallow foundation systems.

Estimated Settlement Values	
Estimated Total Settlement	1.0 inches
Estimated Differential Settlement	0.75 inches

7.0 Recommended Earthwork Specifications – Small Projects

7.1 GENERAL

7.1.1 Description of Work

A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for general earthwork construction including, but not limited to, the following:
   1. Site preparation.
   2. Excavation.
   3. Underpinning.
   4. Filling and backfilling.
   5. Grading.
   6. Soil Disposal.
   7. Clean Up

7.1.2 Definitions

A. Unsuitable Materials:
   1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 3 inches; organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D1557.
   2. Existing Subgrade (Except Footing Subgrade): Same materials as 7.1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
   3. Existing Subgrade (Footings Only): Same as 7.1.2.A.1, but no fill or backfill. If materials differ from design requirements, excavate to acceptable strata subject to the Geotechnical Engineer's approval.

B. Building Earthwork: Earthwork operations required in area enclosed by a line located 5 feet outside of principal building perimeter. It also includes earthwork required for auxiliary structures and buildings.

C. Trench Earthwork: Trench work required for utility lines.

D. Site Earthwork: Earthwork operations required in area outside of a line located 5 feet outside of principal building perimeter and within new construction area with exceptions noted above.
E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through use of data provided from results of field test procedures presented in ASTM D1557, ASTM D2167, and ASTM D6938.
F. Fill: Satisfactory soil materials used to raise existing grades. In the project construction documents and drawings, the term "fill" means fill or backfill as appropriate.
G. Backfill: Soil materials or controlled low strength material used to fill an excavation.
H. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization by the Project Engineer.
I. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular fill.
J. Structure: Buildings, foundations, slabs, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
K. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
L. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

7.1.3 Applicable Publications

A. The latest edition of the publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
B. American Society for Testing and Materials (ASTM):
D1557 .....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2700 kN m/m3))
D2167 .....Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2487 .....Standard Classification of Soil for Engineering Purposes (Unified Soil Classification System)
D6938 .....Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

7.2 PRODUCTS

7.2.1 Materials

A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.
B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, and SC, or any combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off site sources having a minimum dry density of 110 pcf, a maximum Plasticity Index of 15, and a maximum Liquid Limit of 40.
C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, and SC, or any combination of these groups, or as approved by the Engineer or material with at least 90

percent passing a 1 1/2-inch sieve and not more than 35 percent passing a No. 200 sieve, per ASTM D2940.

7.3 EXECUTION

7.3.1 Site Preparation

A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions.

B. Grubbing: Remove stumps and roots 3 inch and larger diameter. Undisturbed sound stumps, roots up to 3-inch diameter and nonperishable solid objects a minimum of 3 feet below subgrade or the bottom of foundation, slabs and pavements.

C. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations.

7.3.2 Excavation

A. Shoring, Sheeting and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the Geotechnical Engineer, banks of excavations to protect workmen, banks, adjacent paving, structures and utilities.
   1. Design of the temporary support of excavation system is the responsibility of the Contractor.
   2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the Geotechnical Engineer.
   3. Extend shoring and bracing to a minimum of 5 feet below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
   4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall provide a concrete footing, under disturbed foundations, as directed by Geotechnical Engineer, at no additional cost to the Owner. Do not remove shoring until permanent work in excavation has been inspected and approved by Geotechnical Engineer.

B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from Geotechnical Engineer. If the excavation becomes saturated, approval by the Geotechnical Engineer is also required before placement of the permanent work on all subgrades.

C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with concrete or material approved by the Geotechnical Engineer.

D. Building Earthwork:
   1. Excavation shall be accomplished as required by drawings and specifications.
   2. Excavate foundation excavations to solid undisturbed subgrade.

3. Remove loose or soft materials to a solid bottom.
4. Fill excess cut under footings or foundations with properly compacted engineered fill.
5. Do not tamp earth for backfilling in footing bottoms, except as specified.
6. Slope grades to direct water away from excavations and to prevent ponding.

E. Trench Earthwork:
   1. Utility trenches:
      a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
      b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
      c. Support piping on undisturbed earth unless a mechanical support is shown.

F. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities and other items indicated to be removed; together with soil, boulders and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by the project drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements and for inspections. Remove subgrade materials that are determined as unsuitable by this specification and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the Geotechnical Engineer shall obtain samples of the material and determine the soil classification for each sample to determine whether it is unsuitable or not.
   1. Site Grading:
      a. Provide a smooth transition between adjacent existing grades and new grades.
      b. Cut out soft spots, fill low spots and trim high spots to comply with required surface tolerances.
      c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed.

7.3.3 Filling and Backfilling

A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, foundation drainage and pipes coming in contact with backfill have been installed and work inspected and approved by the Geotechnical Engineer.

B. Placing: Place materials in horizontal layers not exceeding 6 inches in compacted depth for material compacted by heavy compaction equipment, and not more than 4 inches in compacted depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen or contain frost.

C. Compaction: Compact with approved tamping rollers, sheepsfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors or other approved equipment (hand or

mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 10 feet of new or existing building walls without prior approval of Geotechnical Engineer. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Compact soil to not less than the following percentages of maximum dry density, according ASTM D1557 as specified below:

1. Fills, Embankments, and Backfill
    a. Under proposed structures, building slabs, steps and paved areas, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material in to 95 percent.
    b. Landscaped areas to 90 percent.
2. Natural Ground (Cut or Existing)
    a. Under building slabs, steps and paved areas, top 6 inches of compacted material to 95 percent.

D. Construction Material Testing
    1. Proctor Testing
        a. A Proctor Test shall be completed in accordance with ASTM D1557 standards to determine applicable moisture to density relationship per each soil type located within the project area.
    2. Density Testing Frequency
        a. Soils located directly under building foundation systems and/or retaining wall systems shall have one proctor test performed every 150-linear foot of foundation per lift.
        b. Soils located directly under building pads shall have one proctor test performed every 5000 Ft^2 per lift.
        c. Soils not located under building pads shall be tested every 10,000 ft^2 per lift.

7.3.4 Grading

A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with SM, SM-SP, or SP.
C. Slope backfill outside building away from building walls for a minimum distance of 5 feet.
D. Finished grade shall be at least 6 inches below bottom line of window or other building wall openings unless greater depth is identified on architectural drawings.
E. Finish subgrade in a condition acceptable to Project Engineer at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.
H. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 0.25 inches of indicated grades.

7.3.5 Disposal of Unsuitable and Excess Excavated Material

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off of the project site.
B. Place excess excavated materials suitable for fill and/or backfill on site where directed.
C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.

7.3.6 Clean Up

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from the project site.

8.0 Limitations

SMA prepared this report for the specific project and location aforementioned in Section 1 and Section 3. SMA conducted this study using the standard level of care and diligence normally practiced by recognized engineering firms now performing services of a similar nature under similar circumstances. This report, including all illustrations, is intended to be used in its entirety.

This report describes SMA's findings and conclusions about subsurface conditions at the locations identified and has based interpretation of the soil and groundwater conditions on data obtained from the borings drilled for this study. Although SMA has allowed for minor variations in subsurface conditions, recommendations may not be appropriate if soil conditions change or are found to significantly vary (as a result of localized geologic conditions) from those encountered during site evaluation. SMA recommends informing and retaining SMA if unanticipated soil conditions are encountered during construction and, if necessary, revise these conclusions.

SMA provided recommendations for foundation system designs based on soil conditions and assumptions of applied loads. Recommendations may not be appropriate if foundation types or loading changes. As such, SMA recommends informing and retaining SMA, when finalized site development and foundation loads are determined in order for SMA to revise soil design parameters, as applicable.

SMA prepared this report for the exclusive use of the Client and Structural Engineer. The purpose is to evaluate the design of the project as it relates to SMA's interpretation of the geotechnical aspects discussed here***. This report should be available to potential contractors for information only and not as a warranty of subsurface conditions***.

Appendix G.R.1

Project Vicinity Map & Bore Locations

SMA
Engineering
Environmental
Geomatics

SOUDER, MILLER
& ASSOCIATES
3500 Sedona Hills ParkwayLas Cruces,
NM 88011
Phone (575) 647-0799 Toll Free (800) 647-0799 Fax (575) 647-0680

VICINITY MAP

GRANT COUNTY TRUCK BYPASS &
CULVERT REPLACEMENT
SILVER CITY, NEW MEXICO

Designed	Drawn	Checked
SVG	DIF	PJP

Date: 05/17/2021
Scale: 1" = 500'
Project No: 7328699
V-1

P:\7-Grant Co Truck Bypass Culvert Replacement (7328699)\Design\Geotechnical Report - Grant County Culvert Replacement\CAD File\Vicinity Map 2.dwg, SVG, 12/2/2021 3:37 PM

SMA
Engineering
Environmental
Geomatics

SOUDER, MILLER
& ASSOCIATES
3500 Sedona Hills ParkwayLas Cruces,
NM 88011
Phone (575) 647-0799 Toll Free (800) 647-0799 Fax (575) 647-0680

BORE LOCATION MAP

GRANT COUNTY TRUCK BYPASS &
CULVERT REPLACEMENT
SILVER CITY, NEW MEXICO

Designed	Drawn	Checked
SVG	DIF	PJP

Date: 05/17/2021
Scale: 1" = 60'
Project No: 7328699
BOR-1

P:\7-Grant Co Truck Bypass Culvert Replacement (7328699)\Design\Geotechnical Report - Grant County Culvert Replacement\CAD File\Boring Location Map.dwg, SVG, 12/2/2021 3:30 PM

Appendix G.R.2

Soil Boring Logs

SOUTHWEST ENGINEERING, INC.

GEOTECHNICAL BORING LOG

Project Name	Grant County Truck Bypass	Date of Field Operations	1-Feb-21
Project Number	41026	Laboratory Number	D1 - page 1
Client	Souder, Miller & Associates		

Depth, ft	Graphic Log	Sample	Sample Type	Standard Penetration Blows per Foot	Liquid Limit	Plasticity Index	Moisture Content, %	Unified Soil Classification	Visual Classification & Description
				3.3.3					
0			S	6	S/NP	S/NP	12.0	SC/SM	Dark brown silty clayey sand with gravel
1									
2				3.4.4					
2.5			S	8	56	46	14.2	CH	Dark brown sandy fat clay with gravel
3									
4				4.4.5					
5			S	9	61	45	15.0	CH	Dark brown sandy fat clay with gravel
6									
7				5.8.6					
7.5			S	14	52	31	14.9	CH	Brown sandy fat clay with gravel
8									
9				10.17.28					
10			S	45	44	24	11.1	CL	Brown sandy lean clay with gravel
11									
12									
13									
14				3.5.11					
15			S	16	S/NP	S/NP	6.0	SM	Brown silty sand with gravel
16									
17									
18									
19									

Sample Type
D - Disturbed
S - Standard Pentration
U - Thin Wall Shelby Tube

Water Table

Water Table at __ Below Existing Site Grade

SOUTHWEST ENGINEERING, INC.

GEOTECHNICAL BORING LOG

Project Name	Grant County Truck Bypass	Date of Field Operations	1-Feb-21
Project Number	41026	Laboratory Number	D1 - page 2
Client	Souder, Miller & Associates		

Depth, ft	Graphic Log	Sample	Sample Type	Standard Penetration Blows per Foot	Liquid Limit	Plasticity Index	Moisture Content, %	Unified Soil Classification	Visual Classification & Description
				2.7.11					
20			S	18	49	32	18.3	CL	Burnt red sandy lean clay
21									
22									
23									
24				3.8.9					
25			S	17	57	37	20.9	CH	Burnt red sandy fat clay
26									
27									
28									
29				5.13.18					
30			S	31	55	34	21.3	CH	Burnt red sandy fat clay
31.5									

Sample Type
D - Disturbed
S - Standard Pentration
U - Thin Wall Shelby Tube

Water Table
Water Table at __ Below Existing Site Grade

SOUTHWEST ENGINEERING, INC.

GEOTECHNICAL BORING LOG

Project Name	Grant County Truck Bypass	Date of Field Operations	1-Feb-21
Project Number	41026	Laboratory Number	D2 - page 1
Client	Souder, Miller & Associates		

Depth, ft	Graphic Log	Sample	Sample Type	Standard Penetration Blows per Foot	Liquid Limit	Plasticity Index	Moisture Content, %	Unified Soil Classification	Visual Classification & Description
				6.5.6					
0			S	11	S/NP	S/NP	10.8	SC/SM	Gray silty clayey sand with gravel
1									
2				8.9.9					
2.5			S	18	48	28	11.8	CL	Brown sandy lean clay with gravel
3									
4				3.5.4					
5			S	9	47	27	11.3	CL	Brown sandy lean clay with gravel
6									
7				4.5.5					
7.5			S	10	46	22	11.9	CL	Brown sandy lean clay with gravel
8									
9				3.4.5					
10			S	9	46	24	11.6	CL	Brown sandy lean clay with gravel
11									
12									
13									
14				4.3.3					
15			S	6	39	22	13.2	CL	Dark brown snady lean clay
16									
17									
18									
19									

Sample Type
D - Disturbed
S - Standard Pentration
U - Thin Wall Shelby Tube

Water Table
Water Table at __ Below Existing Site Grade

SOUTHWEST ENGINEERING, INC.

GEOTECHNICAL BORING LOG

Project Name	Grant County Truck Bypass	Date of Field Operations	1-Feb-21
Project Number	41026	Laboratory Number	D2 - page 2
Client	Souder, Miller & Associates		

Depth, ft	Graphic Log	Sample	Sample Type	Standard Penetration Blows per Foot	Liquid Limit	Plasticity Index	Moisture Content, %	Unified Soil Classification	Visual Classification & Description
				3.7.6					
20			S	16	42	26	12.3	CL	Burnt red sandy lean clay
21									
22									
23									
24				2.5.6					
25			S	11	50	31	11.7	CH	Burnt red sandy lean clay with gravel
26									
27									
28									
29				7.11.13					
30			S	24	47	29	14.8	CL	Burnt red sandy lean clay
31.5									

Sample Type
D - Disturbed
S - Standard Pentration
U - Thin Wall Shelby Tube

Water Table
Water Table at __ Below Existing Site Grade

Appendix G.R.3

Laboratory Analysis

APPENDIX C - LABORATORY ANALYSIS

SAMPLE HANDLING

After recovery, our engineering staff removed the soil samples from the samplers in field. They examined the samples, visually classified them, and preserved representative portions of each sample for laboratory testing. They also obtained strength estimates of most cohesive samples in the field using a calibrated hand penetrometer or a Torvane.

SOIL CLASSIFICATION

Soil Classifications provide a general guide to the engineering properties of various soil types. Representative samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on our Test Boring Records.

The classification system discussed above is primarily qualitative and for detailed soil classification two laboratory tests are necessary: grain size tests and index tests. Using these test results the soil can be classified according to the AASHTO, FAA, or Unified Classification Systems (ASTM D2487). These soil classifications and the in-place physical soil properties provide and index for estimating the behavior of the soil.

GRAIN SIZE TESTS

Grain size tests are performed to determine the distribution of particle sizes. The soil samples are prepared for testing according to ASTM D421 (dry preparation) or ASTM D2217 (wet preparation). The grain size distribution of soils coarser than a number 200 sieve (0.074 mm opening) is determined by passing the samples through a standard set of nested sieves. Usually, these are sandy or gravelly soils. Materials passing the No. 200 sieve are the percent fines (silt and clay sizes). Using a hydrometer, these particles are suspended in water and the particle size distribution calculated from the measured settlement rate.

INDEX TESTING

Index tests are performed to determine the soil classification and plasticity characteristics. Generally, index tests are conducted on clayey and silty soils. The soil plasticity characteristics are defined by the Plastic Limit (PL) and the Liquid Limit (LL). The PL and LL are determined in accordance with ASTM D4318 and are referred to as the Atterberg Limits.

PHYSICAL SOIL PROPERTIES

The in-place physical properties are described by the specific gravity, wet unit weight, moisture content, dry unit weight, void ratio, and percent saturation of the soil. The specific gravity and moisture content are determined according to ASTM D854 and D2216, respectively. The wet unit weight is found by obtaining a known volume of the soil and dividing the wet sample weight by the known volume. The dry unit weight, void ratio and percent saturation are calculated values.

SOUTHWEST ENGINEERING, INC.

TABULATION OF LABORATORY LAB RESULTS

PROJECT: Grant County Truck Bypass

PROJECT#: 41026

CLIENT: Souder, Miller & Assoicates 01-Feb-21

LOCATION	Depth (feet)	Moisture (%)	Sieve Analysis - Accumlative Passing											Plasticity Index	Liquid Limit	ASTM
			2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#80	#200			
Test Hole D1	0.0 - 2.5	12			100	98	91	85	69	53	28	21	17.7	S/NP	S/NP	SC/SM
	2.5 - 5.0	14.2				100	96	90	69	51	35	29	26.4	46	56	CH
	5.0 - 7.5	15				100	90	88	83	71	53	47	42.6	45	61	CH
	7.5 - 10.0	14.9					100	86	79	69	65	55	47	31	52	CH
	10.0 - 15.0	11.1				100	90	85	75	62	44	37	32.4	24	44	CL
	15.0 - 20.0	6			100	73	62	58	52	44	30	24	19.2	S/NP	S/NP	SM
	20.0 - 25.0	18.3				100	99	98	93	82	62	54	50.6	32	49	CL
	25.0 - 30.0	20.9					100	99	92	84	69	62	59.5	37	57	CH
	30.0 - 31.5	21.3						100	99	93	73	66	63.5	34	55	CH

LOCATION	Depth (feet)	Moisture (%)	Sieve Analysis - Accumlative Passing											Plasticity Index	Liquid Limit	ASTM
			2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#80	#200			
Test Hole D2	0.0 - 2.5	10.8				100	97	92	78	58	32	27	24.6	S/NP	S/NP	SC/SM
	2.5 - 5.0	11.8				100	95	92	83	64	41	36	32.9	28	48	CL
	5.0 - 7.5	11.3				100	93	90	80	64	41	35	31	27	47	CL
	7.5 - 10.0	11.9			100	93	93	91	76	63	42	36	31.8	22	46	CL
	10.0 - 15.0	11.6			100	93	87	87	75	63	43	37	34	24	46	CL
	15.0 - 20.0	13.2				100	91	91	87	82	70	64	55.8	22	39	CL
	20.0 - 25.0	12.3					100	97	94	81	52	45	26.7	26	42	CL
	25.0 - 30.0	11.7			100	96	95	94	85	59	48	44	34.2	31	50	CH
	30.0 - 31.5	14.8						100	94	82	56	46	40.8	29	47	CL

Appendix G.R.4

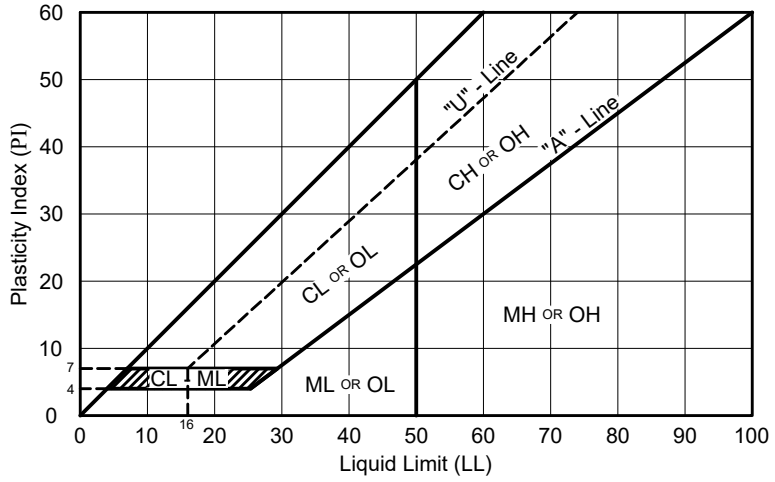
USCS Soil Classification System

Soils are visually classified by the Unified Soil Classification system on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Test are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For more detailed description of the system, see "The Unified Soil Classification System", Corp of Engineers, US Army Technical Memorandum No.3-357 (revised April 1960) or ASTM Designation: D2487-66T.

MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well-graded gravels, gravel-sand mixtures, little or no fines
					GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (more than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)			SW	Well-graded sands, gravelly sands, little or no fines
					SP	Poorly-graded sands, gravelly sands, little or no fines
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS (Limits Plot Below "A" Line Δ hatched zone on plasticity chart)	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50%)			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50%)			MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CLAYS (Limits Plot Above "A" Line Δ hatched zone on plasticity chart)	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50%)			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		CLAYS OF LOW PLASTICITY (Liquid Limit More Than 50%)			CH	Inorganic clays of high plasticity, fat clays

NOTE: Coarse grained soils with between 5% and 12% passing the No. 200 sieve and fine grained soils with limits platting in the hatched zone on the plasticity chart to have double symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	
Above 3 Inches	
Gravel	
3 In. to No. 4 Sieve	
Coarse Gravel	3 In. to ¾ In.
Fine Gravel	¾ In. to No. 4 Sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (Silt or Clay)	Below No. 200 Sieve

SMA Engineering Environmental Surveying

Souder, Miller & Associates
3500 Sedona Hills Parkway
Las Cruces, NM 88011
Phone (575) 647-0799 Toll Free (800) 647-0799 Fax (575) 647-0680

SMA

UNIFIED SOIL CLASSIFICATION SYSTEM

N/A

Designed	Drawn	Checked
PJP	AD	PJP

Date: Jan 2018

Scale: Horiz: N/A Vert: N/A

Project No:

SC-1

C:\Users\agd\Desktop\new block - Standard\Sei_Soil_Classification_Table.dwg, AGD, 1/10/2018 10:57 AM

Appendix G.R.5

Correlation of Penetration Resistance With Relative Density and Consistency

APPENDIX E

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

(Table 5.3 from Foundation Engineering, 2ND Edition, by Peck, Hanson, Thornburn)

	NO. OF BLOWS, N	RELATIVE DENSITY
	0 - 4	Very Loose
	5 - 10	Loose
Sands:	11 - 30	Firm
	31 - 50	Dense
	Over 50	Very Dense

		CONSISTENCY
	0 - 2	Very Soft
	3 - 4	Soft
Silts	5 - 8	Firm
&	9 - 15	Stiff
Clays:	16 - 30	Very Stiff
	31 - 50	Hard
	Over 50	Very Hard

PARTICAL SIZE IDENTIFICATION:

(ASTM D2487)

Boulders:	Greater than 300 mm
Cobbles:	75 mm to 300 mm
Gravel:	
Coarse -	19 mm to 75 mm
Fine -	4.75 mm to19 mm
Sands:	
Coarse -	2 mm to 4.75 mm
Medium -	0.425 mm to 2 mm
Fine -	0.075 mm to 0.425 mm
Silts & Clays:	Less than 0.075 mm